DISSERTATION ON

A STUDY OF PENETRATING INTRAPERITONEAL ABDOMINAL INJURIES

M.S. DEGREE

BRANCH – I
(GENERAL SUGERY)

THE TAMILNADU

DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU

MARCH 2007

CERTIFICATE

This is to certify that this dissertation entitled "**A STUDY OF PENETRATING INTRAPERITONEAL ABDOMINAL INJURIES** " submitted by DR.C. PRABAKAR to the faculty of General Surgery, The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement in the award of degree of M.S.Degree, Branch – I (GeneralSurgery), for the MARCH 2007 examination is a bonafide research work carried out by her under our direct supervision and guidance.

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DECLARATION

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This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement for the award of M.S. (General Surgery), degree Examination to be held in MARCH 2007.

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ACKNOWLEDGEMENT

I am deeply grateful to my Unit chief Prof. **Dr. K.V. MAHESHWARAN, M.S.,** who inspired me to take this topic of "A study of penetrating intra peritoneal abdominal injuries ", as my dissertation.

I am also very grateful to my Professor & Head of the Department of Surgery, **Prof. Dr. M. Kalyanasundaram. M.S.,** and Senior Professors for their encouragement & teaching for the preparation of my work.

I am also thankful to our **Dean** for the kind permission to utilize the Clinical materials for the study.

I express my gratitude to my Assistant Professors for their kind encouragement and valuable guidance to complete this project.

Without thanking the patients who willingly gave their kind cooperation during the course of the study my work would definitely not get completed. I owe my sincere thanks to my patients.

CONTENTS

A STUDY OF PENETRATING INTRAPERITONEAL ABDOMINAL INJURIES

INTRODUCTION

Trauma ranks along with atherosclerotic arterial diseases and malignancy as a major cause of mortality and morbidity. Injury continues to be the leading cause of death in the first four decades of life. high speed vehicles, decivilization of human race, and terrorism are just few of the predisposing factors of trauma. Major trauma does not respect and restrict itself to one organ or one sytem. Evaluation of a patient with abdominal trauma can be a most challenging task that a surgeon may be called upon to deal with. Penetrating Abdominal injuries may be parietal or visceral or perforating through and through injuries. Visceral injuries may be intraperitoneal or retroperitoneal.

The retroperitoneal structures enjoy the safety produced by the depth of domicile but nevertheless suffers from the ominous potential for delayed presentations. Liver, Spleen, stomach, small bowel, large bowel, are the organs included in this study. Multiorgan injuries exsanguination hemorrhages delayed presentations, and the ominous reputation for high mortality and morbidity are just few of the many reasons which makes this topic of penetrating injuries a fascinating one.

REVIEW OF ANATOMY

A review of the surgical of the abdominal organs is necessary at this juncture to appreciate the various aspects of penetrating abdominal injuries.

LIVER

The liver is the largest gland in the body, weighs about 1500 grams, developed from ventral mesogastrium. it is situated under diaphragm more on right side extending to the left. Liver has two surfaces daiphragmatic and visceral surfaces. liver is held in position by attachment of IVC and hepatic veins. Surgically divided into right and left lobes by a principal plane which passes from medial aspect of gall bladder to IVC posteriorly. the french segmental system divides liver into eight lobes according to blood supply. Blood supply is by hepatic artery and portal vein supplying 25% and 75% of total blood supply respectively they supplying 50% of oxygen each. Drained by right, middle and left hepatic veins and also about 10 to 15 small veins drain directly into IVC. Bile ducts drain bile which is synthesized and excreted by liver.

The ligaments which are attached to the liver are falcifarm tigament right and left triangular ligament, coronary ligament, and lesser omentum. Hepatic artery, common bile duct and portal vein passes through the free border of lesser omentum. Pringle's maneuver is the temporary application of vascular clamp to the free margin of lesser omentum upto a period of 20 minutes to 1hour, indicated in major bleeding from hepatic or perihepatic injury so that bleeding points can be arrested by topical cooling. Inj methy! prednisolone 30 – 40 mg/kg IV have been found to protect the hepatocytes during clamping.

Spleen

Spleen is the largest lymphoid organ in the body developed from dorsal mesogastrium. it lies under diaphragm on the left side of the abdomen closely in contract with 9th, 10th and 11th ribs. It measures 1X3X5 inches, weight 7 oz. Its long axis lie along the line of left 10th rib. The spleen is freely organ of dull red color, roughly the size and shape of a clenched fist. Spleen is freely mobile organ and held in position by lienorenal ligament and gastrosplenic

ligament. Phrenicocolic ligament and gastrosplenic ligament. Phrenicocolic ligament gives additional support. spleen is supplied by splenic artery passes between the layers of lienorenal ligament. At the hilum it breaks up into four or five branches which enter the hilum of spleen is closely related to the tail of pancreas, so concomitant pancreatic and splenic injuries are common.

Spleen act as an immunological filter. It produces opsonin, 'tufstin' – a tetrapepdide that coats white cells to promote phagocytosis of particulate matter, bacteria and aged red cells. it is also a source of properdin, a vital component of alternative pathway of complement activation.

Stomach

The stomach, located in the intrathoracic portion of the abdomen is well protected from injury by the overlying rib cage. It is loosely suspended in the abdomen by the gastrohepatic ligament superiorly, the gastocolic ligament inferiorly and by its attachment to the spleen laterally. In addition to these attachments, it is relatively fixed at the gastroesophageal junction and at the retroperitoneal duodenum. the gastric wall consists of an external serosal layer

followed by three layers of smooth muscle- an outer longitudinal layer, a middle circular layer and an inner oblique layer. A strong submucosal layer is followed by; a mucosal layer with a rich capillary network. This network is supplied by arterioles, which originate in the submusoca.

The stomach is supplied by four major nutrient arteries with extensive collateral circulation between the vascular beds. the left gastric artery most commonly arises from the celiac axis and usually splits into anterior and posterior trunks before it reaches the stomach. Branches from the left gastric artery supply the distal esophagus and cardiac portion of the stomach. the right gastric artery most commonly originates from the common hepatic artery and it anastomoses with the left gastric circulation along the lesser curvature.

The left gastroepiploic artery is a collateral of the splenic artery and supplies the greater curvature. it anastomoses with right gastroepiploic artery in about 75% of cases. the more proximal portion of greater curvature is supplied by the short gastric vessols. which originate from the RT gastroepiploic artery arising from the

gastroduodenal artery supplies the pylorics area and distal greater curvature. venous drainage from the lesser curvature is via the coronary vein to the portal vein. On the greater curvature, drainage is via the short gastric vessels and right and left gastroepiploic veins to the splenic vein.

Small bowel

The small bowel extends from the ligament of Treitz to the caecum and is freely moveable on its mesentery. The fan-shaped mesentery suspends the small bowel and extends from the left side of the second lumbar vertebra downward to the right sacroiliac joint, traversing the transverse colon, duedenum, aorta, inferior venacava, right gonadal vessels, and right ureter. The superior mesenteric artery supplies the jejunum and ilenum, arising from the aorta approximately 2 cm below the celiac trunk. After crossing the uncinate process of the pancreas, it enters the root of mesentery, giving off brances to pancreas, right colic and numerous intestinal vessels before it terminates at the medial aspect of the caecum. Importantly there are no named vessels connecting the root of the mesentery and the retroperitoneum. This allows mobilization of the

right colon and entire small bowel cephalad to the inferior aspect of the pancreas.

Colon

It was commonly believed that right sided injuries did well with primary repair, whereas left-sided injuries were best managed by colostomy. The right colon is derived from the midgut and is supplied by the superior mesenteric artery, whereas the left colon originates form the hindgut and is supplied by the inferior mesenteric vessels. The right colon has a thin wall and a large lumen. The left colon is thicker and more muscular and has a smaller lumen. The right colon absorbs and dehydrates the small bowel contents, whereas the left colon functios primarily for storage. Despite the fact that there are definite anatomical and physiological differences between the right and left colon, both should be treated similarly.

CLINICAL EVALUATION AND GRADING OF INJURIES

Liver Injuries

Liver is largest organ in the abdominal cavity commonly damaged by in blunt and penetrating abdominal trauma and in thoraco abdominal injuries. Because of its size, injuries sufficient to

lacerate liver are associated with injuries to other organs in about 80% cases. 85% of liver injuries are not bleeding at the time of laparotomy and patient tolerate these injuries very well. Most liver injuries will infact reqauire only documentaion and no drainage. The minority of liver injuries therefore require definitive surgical care. The hostory of injury is helpful in that particularly and penetrating injury to the right rib cage or upper abdomen and a patient, who has a hostory of being in shock at the scene following blunt trauma abdomen should be suspected of having a major liver injury.

Grading of hepatic injuries (SCNA Vol.75 No.2 April 1995)

Grade Injury Description (1994 Revision)

I. Haematoma : Subcapsular, <10% surface area

Laceration : Capsular tear, <1 cm deep

II. Haematoma Subcapsular, 10-50% surface area

<3 cm parenchymal depth, <10 cm

in length

	Laceration	: Intraparenchymal, <10 cm Capsular tear
III.	Haematoma	: Subcapsular, >50% surface area or expanding, ruptured subcapsular haemmatoma, (or) intraparenchymal haematoma.
	Laceration	>3 cm parenchymal depth.
IV	Laceration	Parenchymal disruption involving 25-75 % of hepatic lobe or 1-3 Couinaud's segments within a single lobe.
V.	Laceration	Parenchymal disruption involving >75 % of hepatic lobe (or)> 3 Couinaud's segments within a single lobe.
	Vascular	Juxtahepatic venous injuries.
VI	Vascular	Major Hepatic avulsion

After resuscitating the patient, plain x ray abdomen should be taken and its shows altered liver borderm haemoperitoneum and associated rib fractures. Abdominal paracentesis is positive, if large amount of blood presents in the peritoneal cavity. DPL is diagnostic of minimal haemoperitoneum, but not specifi for liver injury. CT is the investigation of choice in multiply injured patients provided patients is haemodynamically stable. Radionuclide scan are rarely done to document location of biliary fistula after repair of hepatic injuries.

Treatment [23]

1. Non-operative management

Indicated in

(1) Simple hepatic parenchymal leceration or intrahepatic haematoma.

(2) No evidence of active bleeding.

(3) Intraperitoneal blood loss <250 ml

(4) Absence of other intra-abdominal injuries, patient should be followed with CT scan.

During observation, if the patient shows any signs of bleeding, arteriography and therapeutic embolisation can be done.

Indications for laparotomy during observations are:

(1) Continying need for blood transfusion, increasing (or) deteriorating vital signs.

(2) Peritoneal signs.

(3) Progressive expansion of haematoma

(4) Haematoma thought to represent a septic focus.

Operative Management

(A) Simple Techniques of Repair:

(1) Drainage of non bleeding injuries rarely performed nowadays.

(2) Compression : small cracks in the capsule can be treated by compression for 5 to 10 minutes to stop bleeding.

(3) Topical agents : The application of surgical or Fibringlue or Avitene is use for when avulsion of Glisson's capsule is present. After application of topical agent to the raw hepatic surface, 5 minutes of

compression with pads is applied. After removal, eletrocautry can be used for any bleeders.

(4) Suture hepatorrhaphy: Horizontal mattress sutures with 1/0 chromic catgut (or) simple continuous suturing with 1/0 chromic catgut can be done, with these measures most of the bleeding stops.

(B) Advanced Techniques of Repair:

(1) Extensive Hepatorrhaphy :

If simple suturing fails to stop, multiple horizontal mattress sutures are made in teh parenchyma, but bleeding from intralobar branches of hepatic artery, portal vein (or) hepatic vein are not controlled by this method.

(2) Hepatotomy with selective vascular ligation :

It is indicated when bleeding vessels present deeply. Hepatotomy is done with finger fracture technique. Bleeding vessels and biliary radicals are identified and ligated.

(3) Omental Pack: In 1975 Stone and lamb first described the use of a viable pedicle of omentum placed into deep lobar lacerations to control hemorrhage at the

base. Pedicled omentum from transverse colon can be placed over liver laceration to control bleeding, especially in bare area of liver. Omentum fills the defect and it is fixed with sutures.

(4) Debridement with selective vascular ligation: It is indicated whenever there is loose friable and partially desvascularised hepatic tissue on the edge of liver or in a hepatic laceration or missile tract. It is used in preference to anatomic segmentectomy or lobectomy, as these techniques frequently sacrifice large amounts of normal hepatic tissue.

(5) Resection : It is indicated in the case of total disruption of lobe or segment, in the form of lobectomy or segmentectomy for that, a knowledge of the anatomy is imperative.

(6) Selective hepatic artery ligation: When selective vascular ligation fails, ligation of hepatic artery is an alternative. It may produce dramatic haemostasis without

subsequent liver failure, but this should be done as close to liver as possible and only as a last resort.

(7) Peri hepatic packing: This technique involves the insertion of laparotomy pads or rolls of gauze around the injured liver not into hepatic lacerations. It is indicated in the following situations.

(a) Lack of facilities, blood or experience in dealing with hepatic trauma.

(b) Transfusion included coagulopathy.

(c) Continued bleeding after performance of routine measures.

(d) Bilobar injury.

(e) Suscapsular hematoma.

(f) Profound hypothermia with hemodyanamic or cardiac instability.

Packs can be removed 12 hours after packing. Rebleeding and sepsis are common complications.

(8) Drainage : Open penrose drainage has been used after operative treatment, but incidence of intra abdominal sepsis is common.

(9) Gel foam pack & minsed fibres of rectus muscles may be used as pack.

(10) H_2O_2 application will control generalised oozing from superficial hepatic abrasions.

Current Approach to hepatic injuries (Maingot's abdominal

operations tenth edition)

(a)Extension of Pringle times (> 60 minutes)- Even after effective pringle's maneuver, if the bleeding continues from liver injury, it comes from hepatic vein injury.

(b) Hepatotomy with selective vascular ligation in preference to crushing mattress sutures.

(c)Debridment in preference to major resection.

(d) Omental 'pack' to deep cracks or hepatotomy sites.

(e)Perihepatic pad packing for oozing from

coagulopathies 95%)

(f) Closed suction drains..... alone ?

Complications:

Significant complications following liver injury include,

(1) Pulmonary complications

(2) Coagulopathy

(3) hypoglycaemia

(4) Jaundice

(5) Biliary fistulas

(6) Haemobilia

(7) Subdiaphragmatic and intraparenchymal abscess formation.

Splenic Injuries

The Spleen is the intra-abdominal organ most frequently injured in blunt trauma. In penetrating trauma wound of entry or exit in the left chest, flank or left upper abdomen should arouse suspicion of splenic injury. The clinical picture of splenic injury includes left upper quadrant abdominal pain, signs of blood loss and pain in the left shoulder (Kehr's sign)

Grading of Splenic injury (Shacford)

Surgical clinics of North America Vol -75, No:2 April 1995)

Grade	Injury description
I. Haematoma	Subcapsular, non expanding <10% surface area
	Laceration capsular tear, non bleeding <1 cm parenchymal depth
II Haematoma	Subcapsular,non expanding 10-50% surface area
	Intraparenchymal, non expanding <2cm in diameter.
	Laceration Capsular tear, 1-3 cm parenchymal depth in
	Which does not involve a trabecular vessel.
III. Haematoma	Subcapsular, <50% surface area or expanding;
	raptured Subcapsular or parenchymal
	Haematoma ; intraparenchymal haematoma >2 cm or
	expanding. Laceration >3 cm parenchymal depth or involving trabecular

vessels.

IV Laceration Laceration invlolving segmental or hilar vessels producing major devascularization (>25% of Spleen)

V Laceration Completely shattered spleen Vascular Hilar vascular injury which devascularizes spleen.

❖ **Management**

The management of splenic injury has been subject of major reexamination over the past decade and the recognition of fatal pneumococcal septicemia in patients undergoing splenectomy has led to an interest in splenic salvage. (D.B.Hyot and A.R.Moossa et al)

Plain abdominal films may show

(1) Enlargement of splenic shadow

(2) Elevation of left hemidiaphragm

(3) Medical displacement of splenic shadow or stomach

(4) Widening of the space between the splenic flexure and peritoneal pad. Peritobeal lavage should be perfomed when

there is possibility of splenic injury, positive indicates laparotomy.

Ultrasound, CT Scanning and Radionuclide scanning can reveal significant splenic injury but should only be pursured with an understanding of what therapeutic plan will follow if these tests are positive. [31]

The non operative approach to the splenic injury and spleen conserving surgery have been practiced now in major trauma centres with help of CT and radionuclide scan.

I. Non operative management:

Criteria for non operative management of splenic injury: [4]

(a)Blunt trauma

(b) An isolated splenic injury

(c)If the patient presents more than 12 hours after injury or haemodynamically stable with no others signs of abdominal injury.

(d) Patient should be fully alert (No head Injury or Intoxication)

The risk of non-operative management are missed injury to other viscera and delayed rupture of subcapsular haematoma. During observation patient should be followed sequentially with CT scan.

II. **Spleen conserving surgery: [4,19] – SPLENORRAPHY**

Contra Indications:

During the course of laparotomy the spleen is evaluated for hemorrhage. Splenorraphy is not attempted.

(1) If it is a multiple injury case.

(2) Patient is in shock (systolic pressure less than 90 mm) (or)

(3) There are medical contraindications to prolonged surgery (bleeding disorder, cardiac,pulmonary (or) hepatic discease.

If the patient condition is favourable the decision to repair is based on the state of the spleen. Generally, grzde IV and grad V injuries are not suitable for repair.

Indications:

Splenorraphy can be attempted in grade I, II and III.

Techniques of Splenorraphy: [4,19]

The following are the techniques for splenic repair

(1) Local hemostatic agents – Gelatin foam, surgical cellulose, microfibrillar collagens, thrombin, cyanoacrylate, autologous fibrin glue can be used for superficial tears which are not bleeding actively. But often pressure alone may be sufficient. Non bleeding tears are best left alone.

(2) Suture repair: Deep parenchymal tears are managed by this technique. After removal of the clot and loose devitalized tissue, the wound is inspected, arterial bleeders are controlled and the parenchyma is approximated using deep mattress surures- vertical (or) horizontal including the fibrous capsule using absorbable sutures.

(3) Partial splenectomy: Polar injury which is grade IV can be managed by segmental devascularisation and

debridement by finger fracture technique at the line of demarcation. Additional security to the suture line after suture repair (or) partial spelnectomy can be achieved by omental wrap. Buntain et al [4] have described an absorbable suture ladder to wrap the spleen.

(4) Splenic artery ligation: It has also been described to achieve hemorrhage control. But it is not practiced frequently.

(5) Heterotropic autotransplanation of the splenic tissue: If the patient's condition permits, the splenic function can be preserved even after splenectomy by autotransplantation at sites like gastrocolic omentum, rectus sheath, anterior abdominal wall. Although splenic tissue has excellent ability to regenerate, the amount of splenic tissue remaing is important. To be effective in preserving adequate splenic function, approximately one third of the original spleen must

remain and be nourished by an adequate circulation. This is the procedure of choice especially in children.

III. **Splenectomy :**

Indicated in

(1) Shattered or avulsed spleen

(2) Severely hypotensive patients

(3) Associated with other severe injuries

(4) Undue delay in attempting to repair the spleen.

Complications of splenectomy

(1) Early transient thrombocytosis, which resolved spontaneously over 1-3 months.

(2) Acute dilatation stomach

(3) Delayed Haemorrhage

(4) Pancreatitis

(5) Subphrenic abscess

(6) Left lower lobe atelectasis

(7) Left pleural effusion

(8) And fatal pneumococcal septicaemia (over wheming post splenectomy syntrome OPSI) King H, Shumacker

HB et al. [19] Can be overcome by administering POLY VALENT ANTI PNEUMOCOCCAL – once in 5 yrs given life long.

Gastric Injuries

Injuries of stomach are common in penetrating trauma but very rare in blunt trauma. The stomach is intrathoracic, partially protected by rib cage and any penetrating wound in this area should be suspected of causing injuring to stomach. After resuscitation, a nasogastric tube is placed that serves both diagnostic and therapeutic functions. The return of gross blood on nasogastric aspirate is suggestive of an upper gastrointestinal injury. Haematemesis or bright red blood per nasogastric tube was present in 45% of gunshot wounds and 37% of stab wounds in series of patients with gastric injuries treated at Parkland memorial hospital. [23] The nasogasteric tube also serves a therapeutioc function by decompressing the stomach.

Operative management

The intraoperative evaluation of stomach injury includes good visualization of the esophageal hitaus, evaluation of the anterior portion of the stomach, division of gastrocoloc ligament and complete visualization of the posterior aspect of the stomach. Penetrating wounds are debrided and primary closure performed (Moossa A.R.et al). [26] Despite the rich blood supply of the stomach, a few cases of gastric necrosis have been documented. Garfinkle reported one case of ischaemic gastric necrosis along the greater curvature that he attributed to avulsion of the gastroepiploic vessels. Laceration of stomach may require gastirc resection. Post operative complications include intrabdominal abscess, particularly in the lesser-sac. Other complication is gastric fistula, needs immediate reoperation and repair.

Small bowel injuries :

Injuries to the small bowel are present in approximately 25-30% of the patients who require laparatomy after penetrating trauma. (Moossa A.R. et al). [26] Stab injuries are usually less severe than gunshot or blunt mechanisms of injury. In most patients who sustain

stab wounds the small bowel is spared because the mobility of small bowel afforded by the redundant mesentry, allows the intestine to slide away from an offendig knife blade. (SCNA Vol 70 No:3 June 90)

Evalution and Diagnosis

Although history and physical examination are valuable in the diagnosis of small bowel injury following penetrating trauma, these alone are not sufficiently accurate.

Stabogram to define periotoneal violation by injecting contrast into the stab wound tract and searching for intraperitoneal spillage radiographically and a hogh false-negative rate causes this procedure to be largely abandoned.

Any patient who has peritoneal signs eviseration or haemodynamically unstable proceeds promptly to exploratory laparotomy. In stable asymptomatic patients the wound is explored locally to assess for peritoneal penetration. If peritoneal penetration confirmed or is equivocal peritoneal lavage is employed. Even in stable patients in whom there may be intra peritoneal injury still laparotomy is indicated for the fear of retained radiolucent foreign

body like cloth. In equivocal cases diagnostic peritoneal lavage is useful in penetrating injury. The RBC count is clearly is the most sensitive indicator for exploratory lapratomy. Gunshot wounds present a much greater risk for significant intra-abdominal injury. Consequently all gunshot wounds traversing or in proximity to the peritoneal cavity are explored.

Treatment

At operation, significant bleeding will be the first priority. The small bowel should be carefully examined from the ligament or Tretiz all the way to the ileocaecal value. Contusion of the antimesentric wall of the bowel nay result in delayed perforation and seromuscular sutures can be used to impricate the contusion into the lumen. Single holes from stab wounds or shotgun pellets can be closed without debridement. Since penetrating injuries in general occurs in pairs, careful examination of the bowel wall on the opposite side must be done to avoid missing any small perforations. If two adjacent holes are found they can be connected across the bridge of bowel and a transverse closure effected, so as not to narrow the lumen. Bowel resection and primary enteroenterostomy is

indicated if the length of an enterorrhaphy exceeds one half of the bowel diameter, multiple injuries occuring in proximity or segment of bowel is devascularized. Mucosal prolapse is a laparotomy finding in traumatic perforation of duodenum and small bowel; which is absent in pathological perforation-**this is of medicolegal importance**

Mesentric haematoma more than 2 cm, expanding, uncontained or near the root of mesentry requires exploration with proximal control of the vessels.

Complications

Haemorrhage, Intra-abdominal abscess, anastomatic leakage, enteroocutaneous fistula and intestinal obstruction. (Moossa A.R. et al) [26]

Colonic injuries

Philip. J.Huper. JR and Ervin.R.Thal er al 30 has summarized the recent concept in the management of colonic injuries in the SCNA. Vol 70 no. 3 june 1990. The conclusion are

1) primary repair is safe in carefully selected cases.

2) Colostomy should not be abandoned because of a fear of morbidity associated with its closure.
3) The difference between injuries on the right and the left colon is questionable and probably not as significant as previously thought
4) Exteriorized repair frequently requier conversion to colostomy and probably has little indication for use.
5) Short term perioperative antibiotic coverage is sufficient.
6) Wounds are left open in patients with significant contamination.

Protocal

The protocol to be followed in colonic injury is:

i Retroperitoneal parts of the colon like Ascending & Descending – colon.

a) Ascending colon- single layer closure with ileotransverse colostomy. Descending colon-single layer closure with proximal defunctioning transverse colostomy.

ii Intraperitoneal parts like Transverse colon & Sigmoid colon brought out as colostomy.

AIM OF THE STUDY

The aim of the study is to evaluate the following aspects of penetrating abdominal injuries

- The incidence of penetrating injuries abdomen
- Mode of injury
- Clinical evaluation
- Associated organ and system involvement
- Management
- Prognosis

MATERIALS AND METHODS

This study consists of all penetrating abdominal injuries admitted in the trauma ward of Government Rajaji Hospital, Madurai from March 2004 to June 2006. Once the patient is admitted the name, age, sex and mode of injury are noted. The time interval between admission and time interva between admission and surgery are recorded. After resuscitatig the patients necessary investigations are carried out. In those who are operated, the operative findings and methods of management are recorded. Cases are followed up even after their discharge from the hospital. If death occurs the cause of death is evaluated. In those patients who died before surgery the postmortem findings are noted and reasons are discussed in this study. The above facts are recorded in a proforma, prepared for this study.

OBSERVATIONS

The total number of patients who had sustained penetrating injuries to intra peritonal abdominal organs were 38. During the period total number of cases of abdominal trauma managed were 124. Thus penetrating intraperitoneal abdominal organ injuries account for 30.65 % of the abdominal trauma cases.

In this study of the 38 patients, 31 were male and 7 cases were females. This gives a male to female ratio of 5 : 1. The high incidence of trauma in males may probably be due to the relatively high association of males in acts of violence and vehicular accidents.

Table – 1 : Age ad Sex Incidence

Age group	Male	Female	Total
11-20	4	0	4
21-30	11	2	13
31-40	8	1	9
41-50	4	2	6
51-60	3	1	4
> 60	1	1	2
Total	31	7	38

Table 1 shows the age and sex incidence in this study. The youngest patient was a eleven year ole boy who had sustained penetrating injuries bystabbing by his blood relative ? Psychic. More than 50% of the patients belongs to the age group between 21-

40 years which is the most productive part of one's life. The oldest patients was a 64 year old female who had sustained penetrating injuries by bullgore.

Table – 2

Penetrating injuries : Abdomen

Stab Injury	25
Bullgore	10
Gunshot	1
RTA	1
Others	1
Total	38

As given in the Table 2 Stab injury is the common penetrating trauma accounting for 65.78%. There were 10 cases of bullgore injury. One case of gunshot, one case of RTA & one case of penetrating injury due to falling on to iron rods in a concrete centering work site.

Table -3

Injury of the other organs

Thoracic injuries	8
Long Bone injuries	5
Head injuries	4
Others	1
Total	18

Table 3 shows the associated injuries in penetrating injuries of the abdomen. 8 patients sustained associated thoracic injuries. 5 patients had long bone fractures. 4 patients suffered from head injury and 1 patient sustained cut throat injury. Totally 18 patients had injuries involving other organs. The high incidence of polytrauma with penetrating injuries abdomen indicates the severity of injuries.

The analysis of the time interval between injury & admission

Time Interval	Injury-Admission	Admission -Sugery
< 2 hour	15	10
2-4 hours	9	14
4-6 hours	7	7
6-8 hours	3	1
8-10 hours	2	1
10-12 hours	1	2
> 12 hours	1	3

And admission & surgery is given in the Table 4.

From the table 4 it can be deduced that 31 cases took less than 6 hours form the time of injury to admission. The fastest to arrive was within 30 minutes from the injury. The average time duration between admission and sugery was 4 hours.

Table 5 - Different Structures Affected

Liver	10
Small bowel	14
Spleen	5
Stomach	4
Colon	3
Diaphragm	2

Table 5 shows the different organs injured in the study. Small bowel injury tops the list with 14 cases. This is followed by nd spleen, accounting for 10 and 5 cases each. There were 4 cases of stomach injury and colonic injury accounts for 3 cases. Diaphragmatic injury seen in 2 cases.

DISCUSSION

Small Bowel Injuries :

There were totally 14 cases of small bowel injuries. Of which 10 cases were due to stab injury and 4 cases were due to bullgore injury. The incidence of small intestinal injury following penetrating trauma exceeds 80% with gunshot wound and 30% with stab injuries that penetrate the peritoneum (SCNA Vol - 70 No. 3 June 90).

In this study 10 cases had isolated small bowel injury. In the remaining cases three cases had associated mesenteric tears and one case was associated with tear injuries spleen and stomach injuries separately.

After laparotomy, thorough search for wounds from the ligament of Treitz to the ileocecal valve was done in all small bowel injuries. In this study, 6 cases of hematomas and serosal lacerations of small bowel were 'Turned In' using lembert sutures placed ina trasverse fashion. In 6 case with questionable viability of bowel, we have done resection and anastomosed in two layer transversely using inner continuous 2/0 catgut and outer lembert sutures with 2/0 silk.

The remaining two cases had associated mesenteric tear were presents that were closed with 2 / 0 silk. In all cases thorough peritoneal irrigation with saline done and open drainage was kept.

In our study two patients had wound infection and two had intrabdominal absecess, both of them were treated with conservative management. Nil mortality observed in small bowel injury management.

Liver Injuries :

There were totally 10 cases of liver injury. In this 8 cases were due to stab injury and 2 cases were due to bullgore. The commonest cause of penetrating liver injury in Ben Taub General Hospital, Houston was gun shot wounds accounting for 50.60% and stab injuries accounting for 33.90%. The incidence of associated organ injuries is a significant factor in patients sustaining liver injuries. In this study only 5 cases were isolated liver injuries and remaining 5 were associated with other organ injuries. The different ways in which the 10 cases of liver injuries were managed as follows. Applicaiton of gel foam and suture hepatorraphy was done in 6

cases. In 2 cases there were no active bleeding hence no repair was done. In other 2 cases omental pack was kept in deep lobar laceration to control bleeding. Peritoneal lavage with normal saline was done in all cases and open drainage was kept in all cases.

In this study 2 out of 10 cases died, giving a mortality rate of 20%. Mortality in one case was due to the severe haemorrhage due to associated injuries and one died of septicemia at the end of the 4th post operative day. Two cases developed subphrenic abscess. The mortality rate at the Ben Taub General Hospital in Houston was 10 to 15%. The incidence of post operative perihepatic abscess ranges from 3.5 to 22% (Feliciano D V et al). Post operative peripheric abscess was diagnosed clinically in the patients who remained continuously febrile after 5 to 7 days and had persistant leucocytosis and foul smelling drainage out of open drainage. All the patients were treated conservatively. One patient developed pneumonia with hyperpyrexia and it was confirmed by X ray – chest and treated conservatively. In this study no complicaiton of biliary leak was noticd.

Splenic Injury :

There were totally 5 cases of splenic injury. Of these 5 cases, 4 cases were due to stab injury and 1 case was due to bullgore injury, whereas the series from the Ben taub General Hospital in Houston has reported an incidence of gunshot splenic injuries as 7.6% and stab injuries as 7% among penetrating splenic injuries.

In this study only one case had isolated splenic injuries. one cases was associated with diaphragmatic injuries and two cases had associated pancreatic injury with retroperitoneal hematoma.

In this study all the injured spleen have undergone splenectomy, whereas the series from Ben Taub Hospital, Houston report 45 to 50% of injured spleen have undergone repair instead of splenectomy that too spleenorrhaphy was accomplished in 51% of patients with a penetrating mechaism of injury. But in only 36.7% with a blunt mechanism of injury would be expected to under go spleenorrhaphy. The grading of the splenic injury has a significant impact on treatment. In our study out of 5 patients, 3 patients were hemodynamically unstable and had associated intra abdominal injuries so we couldn't perform spleenorraphy for these patients.

In this study 1 case died in the immediate post operative period due to hypovolumic shock and multiple organ failure. Four patient had fever ranging from 99 F to 102 F up to 4th post operative day. All ofthem were treated conservatively with antibiotics and antipyretics. Three patients had wound infection.

Stomach Injuries :

There were totally 4 cases of stomach injuries. In ths, three cases were due to stab injuries, one case was due to bullgore injueis whereas the series from Ben taub general hospital report an incidence stab stomach injuries as 12.6%.

All cases were associated with other organ injuries. Of which liver injury in 2 cases, splenic injury in 1 case, duodenal injury in 1 case. Pre operatively all cases were confirmed by the passage of bright red blood through the Ryle's tube and presence of free air on an abdominal film. In this study in all stomach injuries, the entrance and exit sites of the penetrating wound was visualized. Then the stomach was closed in two layers utilizing aninner running row of absorbable vicryl or 1/0 chromic catgut placed in full thickness

fashion. This layer is them imbricted with a sero musculr layer of interrupted lembert sutures using 2/0 or 3/0 silk. In one patient after gastrorrhaphy AGJ & JJ was done. That patient died on 4th post operative day due to burst abdomen and septicemia. One more patient died of septicemia due to concomitant colonic injury. One patient developed consolidation of left lower lobe with left subphrenic abscess and two patients had wound infection post operatively both of them were treated conservatively.

In all cases during laparotomy the lesser sac was opened to rule out injuries of the posterior wall of the stomach. In none of the cases, posterior wall injury noted..

In all cases peritoneal irrigation was done with normal saline and open drainage was kept in all cases.

The incidence of intraabdominal abscess in patients with penetrating wounds of the stomach was 5 to 10 percent in the series of Ben Taub general hospital in Houston, which is in accordance with our study also.

Colonic Injuries :

There were totally 3 cases of colonic injuries, all the 3 cases were due to stab injuries. In this study, two patients had mild hematoma of transverse colon which were turned in by lembert sutures transversely with 2/0 silk.

One patient had injury to transverse colon, and liver. The injury was repaired primarily by using 2/0 Silk interupted sutures in two layers. Patient expired on 4th post operative day due to septicemia. In all cases thorough peritoneal irrigation and open drainage was kept. In this study two patients had wound infection post operatively and treated conservatively.

Diaphragmatic Injuries :

There were totally 2 cases of diaphragmatic injuries. Of which one case was due to stab injury and one case was due to bullgore injury. Both the cases were associated with intraabdominal injuries of which, one case was associated with stomach and one case associated with solenic injury.

In both the cases repair was done through abdominl approach only. The rent was closed with no. 1 prolene non absorbable suture

material or with figures of eight sutures. In all cases ICD was done after closure.

Negative Celiotomies :

In this study, there were 4 cases of negative celiotomies. Whereas in Feliciano et al 1984, shorr et al 1988 series, the negative celiotomies was from 5.8% to 7.4%. In this study after confirmation of peritoneal penetration by wound exploration, exploratory laparotomy was done in all cases. There was no viscus or vascular injury, and there was no missed injury in our study. All were discharged after an uneventful post operative period.

Mortality and Morbidity

There were totally 6 deaths in the study of 38 cases, constituting a mortality rate of 13.12 %. Morbidity in mild to severe forms occured in all patients who survived.

The break up of the death cases is as follows :

Liver	2
Coloic	1
Stomach	2
Spleen	1

The severe degree of morbidity occured in the form of residual abscess, duodenal fistula, post operative lung infections etc., The mild form of morbidity were due to wound infection.

Spjut-patrinely V. Feliciano DV, Ben taub General hospital Houston has reported in a series of 300 consecutive patients with penetrating abdominal injuries, a overall mortality rate of 15%. In our study the mortality rate was 13.7% and it included only those patients arriving to the hospital alive. Hence the prehospital mortality having been excluded, and 13.7% mortality rate is comparable with literature.

CONCLUSION

- Penetrating intra peritoneal abdominal injuries constitute 30.65% of the abdominal injuries
- In this study stab injury is the commonest mode of producing penetrating intraperitonal abdominal injuries / within our region.
- In this study more than 50% of the patients belong to the age group between 21-40 years which is the most productive part of one's life.
- In this study male to female ratio was 5 : 1 and the high incidence of trauma in male may probably due to the relatively high association of males in acts of violence and vehicular accidents.
- Small bowel, liver and spleen are the three most frequently injured organs in order of sequence.
- There was no appreciable delay in taking of the patients to our hospital and hence our management results were enhanced.
- Multiple organ injuries were the rule in retroperitoneal trauma

- The overall mortality of penetrating abdominal injuries in this study was 13.7% and morbidity was 19%.
- Hypovolemic shock due to bleeding and sepsis were the major causes of death.
- Mortality within 6 hours is mainly due to massive blood loss and shock.
- In the Rest of the cases is mortality is due to hypovolumic shock, septicaemia, and multi organ failure.

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PENETRATING INTROPERITONEAL ABDOMINAL INJURIES

PROFORMA

Name : Age : Sex :

Occupation :

Date and time of injury :

Date and time of admission :

Time interval between injury and admission :

Nature of injury

1. Stab 2. Bullgore 3. RTA 4. Others

Clinical parameters on Admission :

Consciousness Pulse BP Respiration CVS Urine output

Abdominal findings :

Associated Injuries :

1. Head injury 2) Thoracic 3) Fracture iv) Others

Investigations :

Urine HB Bloood Urea Blood grouping

Blood sugar Radiological findings.

No.of bloood transfusions :

Date and time of surgery

Time interval between injury and surgery

Operative findings

Procedure done

Prognosis

Complication and its management

Post Mortem Findings in case of Death.